Introduction to Software Defined Radio (SDR) - A Hands-on Course

Class 4: Exploring SDR with the RTL-SDR, Part 2

September 28, 2017

Charles J. Lord, PE
President, Consultant, Trainer
Blue Ridge Advanced Design and Automation

Presented by:

DesignNews CEC CONTINUING EDUCATION CENTER Blue Ridge Advanced Design and Automation Asheville, North Carolina Digi-Key ELECTRONICS ROHDE&SCHWARZ

This Week's Agenda

9/25 Intro to SDR

9/26 RF and Radio Basics

9/27 Exploring SDR with the RTL-SDR, Part 1

9/28 Exploring SDR with the RTL-SDR, Part 2

9/29 Commercial SDR Designs

This Week's Agenda

9/25 Intro to SDR

9/26 RF and Radio Basics

9/27 Exploring SDR with the RTL-SDR, Part 1

9/28 Exploring SDR with the RTL-SDR, Part 2

9/29 Commercial SDR Designs

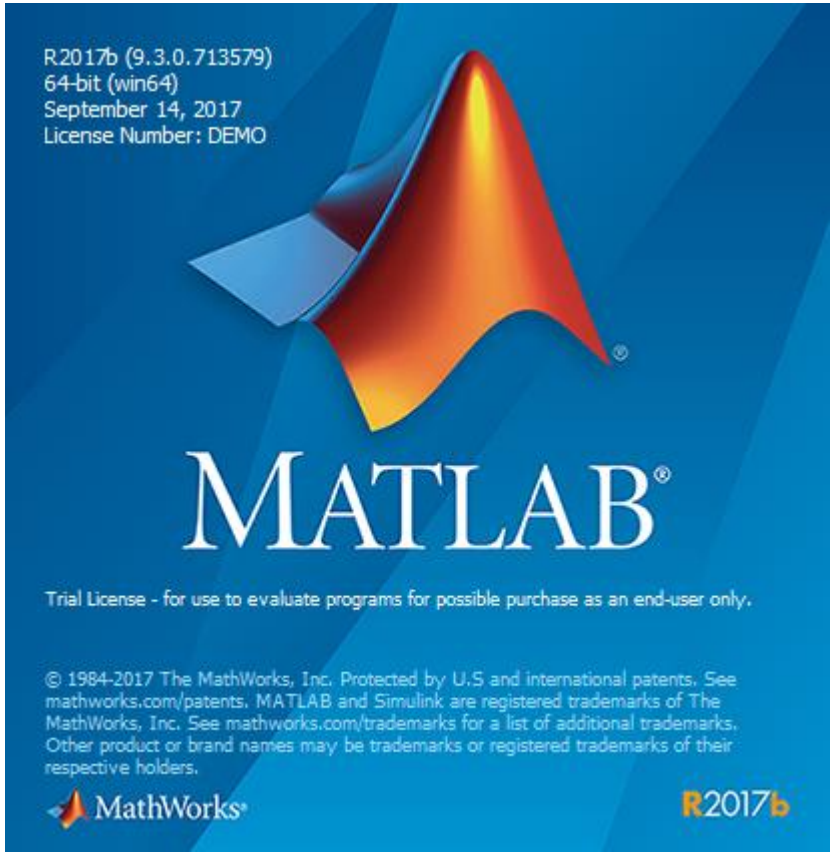
More Fun with the RTL-SDR

- We saw a lot of basics in the operation of SDR#
- Now we want to look at how we can write some of our own code
- We will look briefly at Matlab and Python

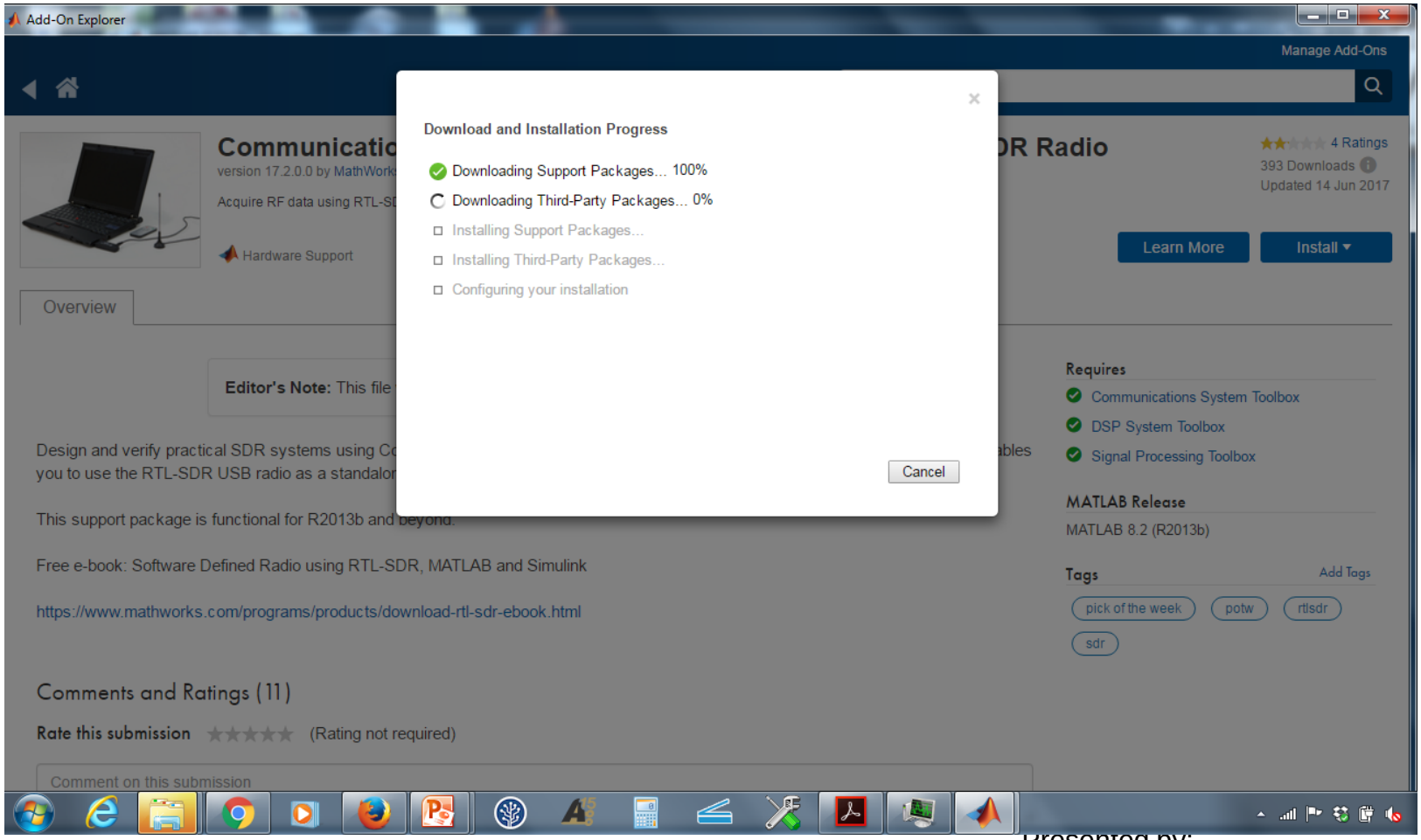
From Yesterday

- Sign up for the free 30-day trial of Matlab and Simulink at *https://www.mathworks.com/programs/trials/trial_request.html*
- *Get the RTL-SDR support package from https://www.mathworks.com/hardware-support/rtl-sdr.html*
- *Under "Supported Hardware" download the free book and files*

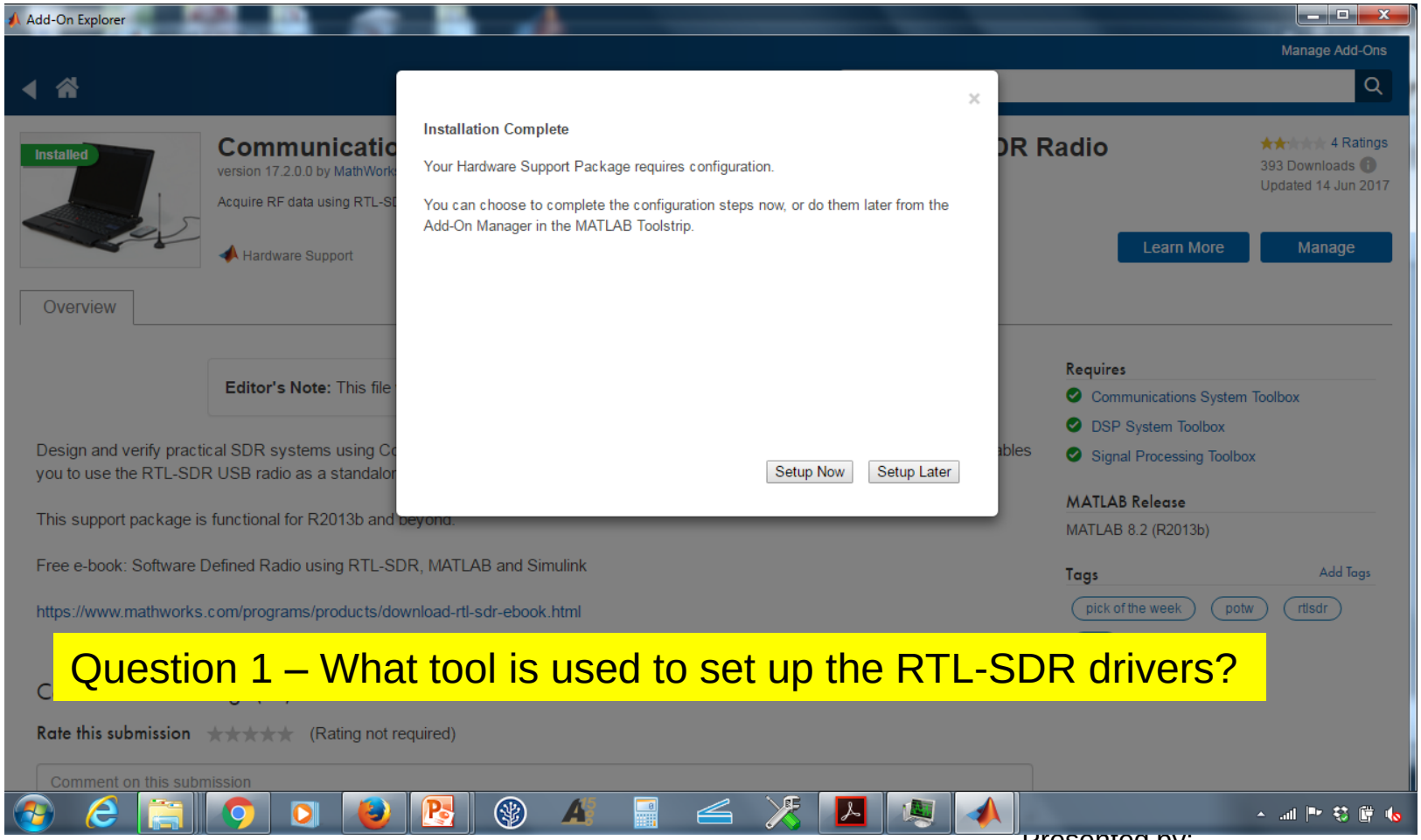
Latest version – released 9/14



Then We Need RTL-SDR Support

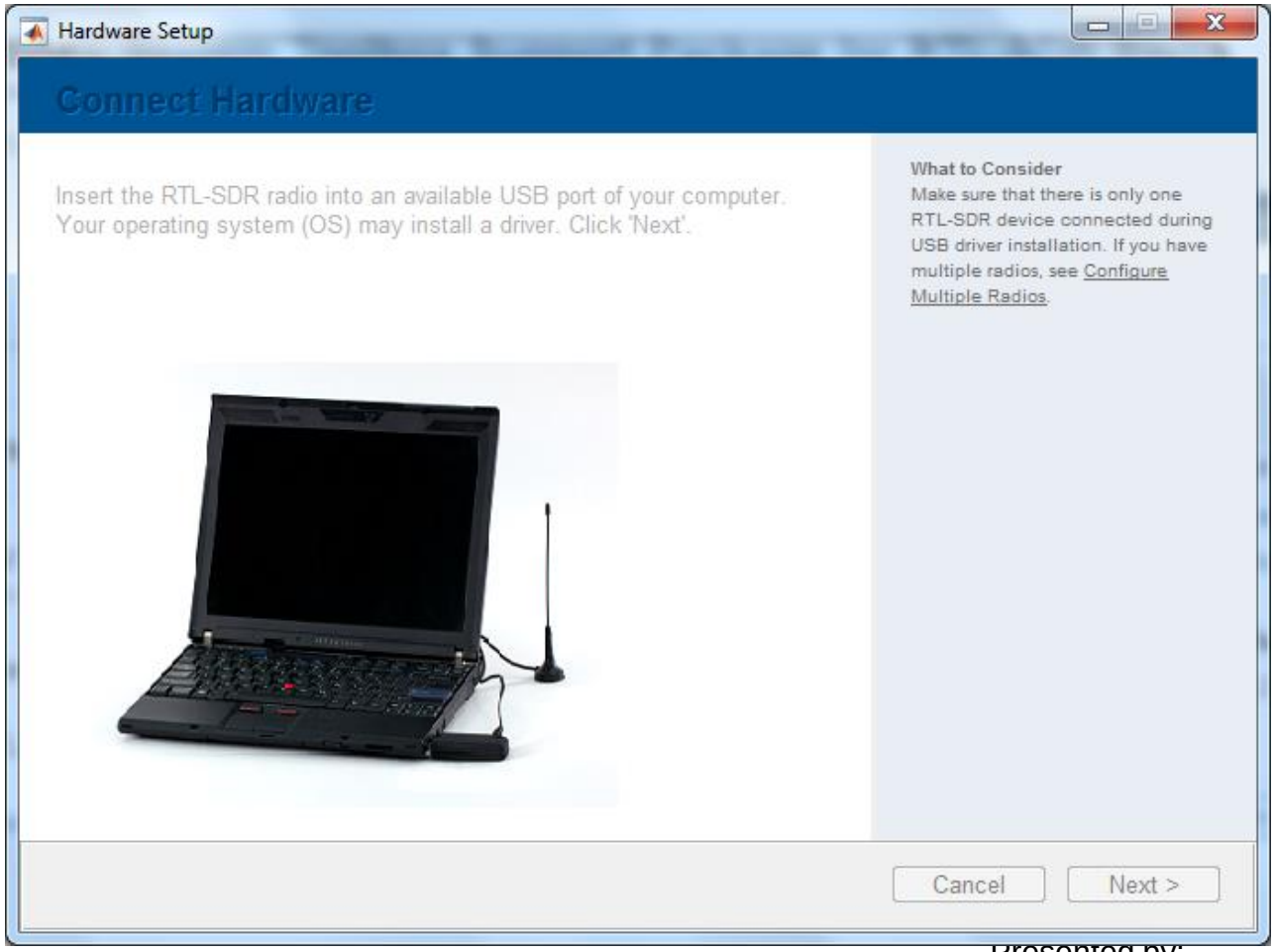


Now To Set Up

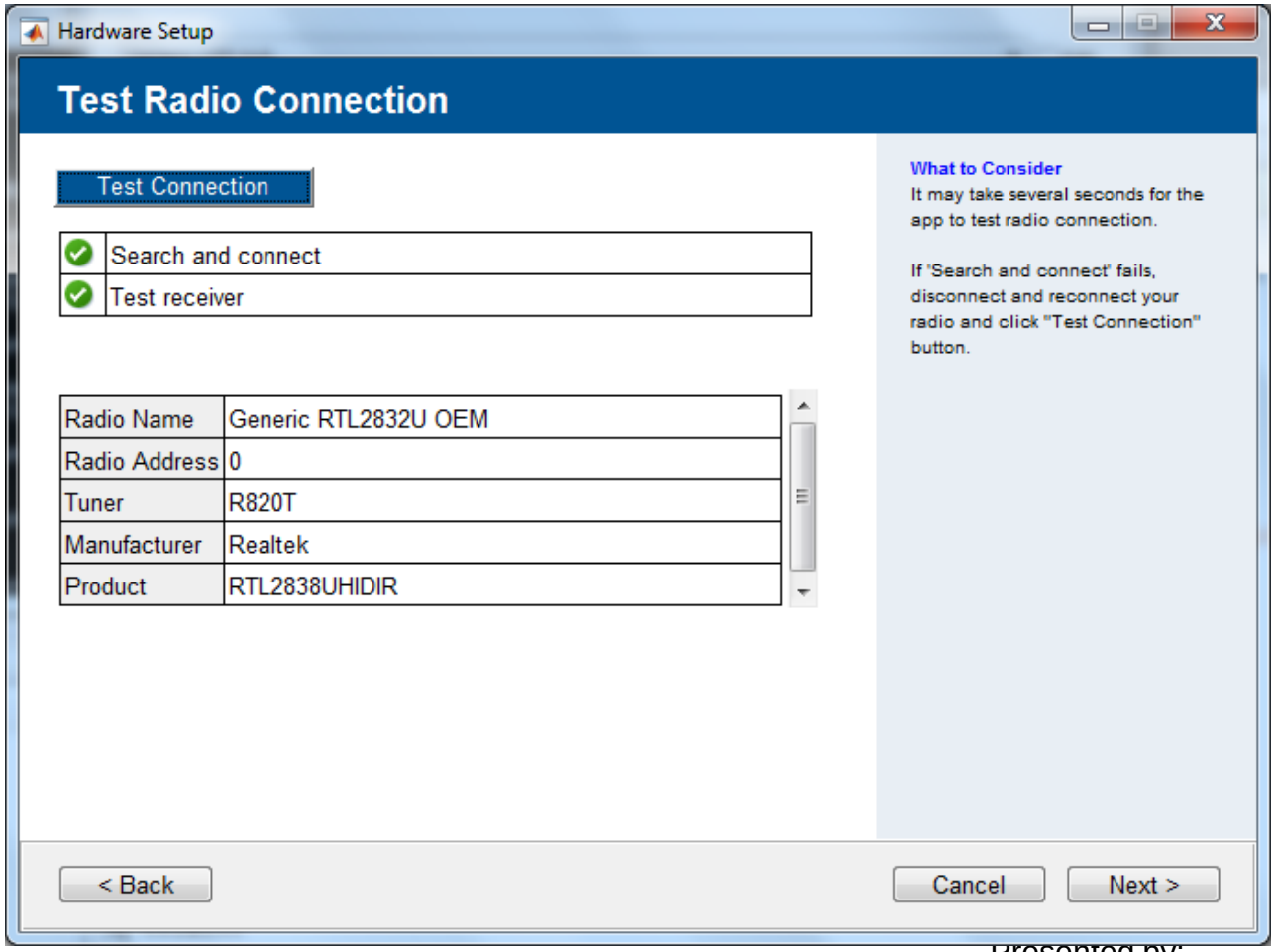


Question 1 – What tool is used to set up the RTL-SDR drivers?

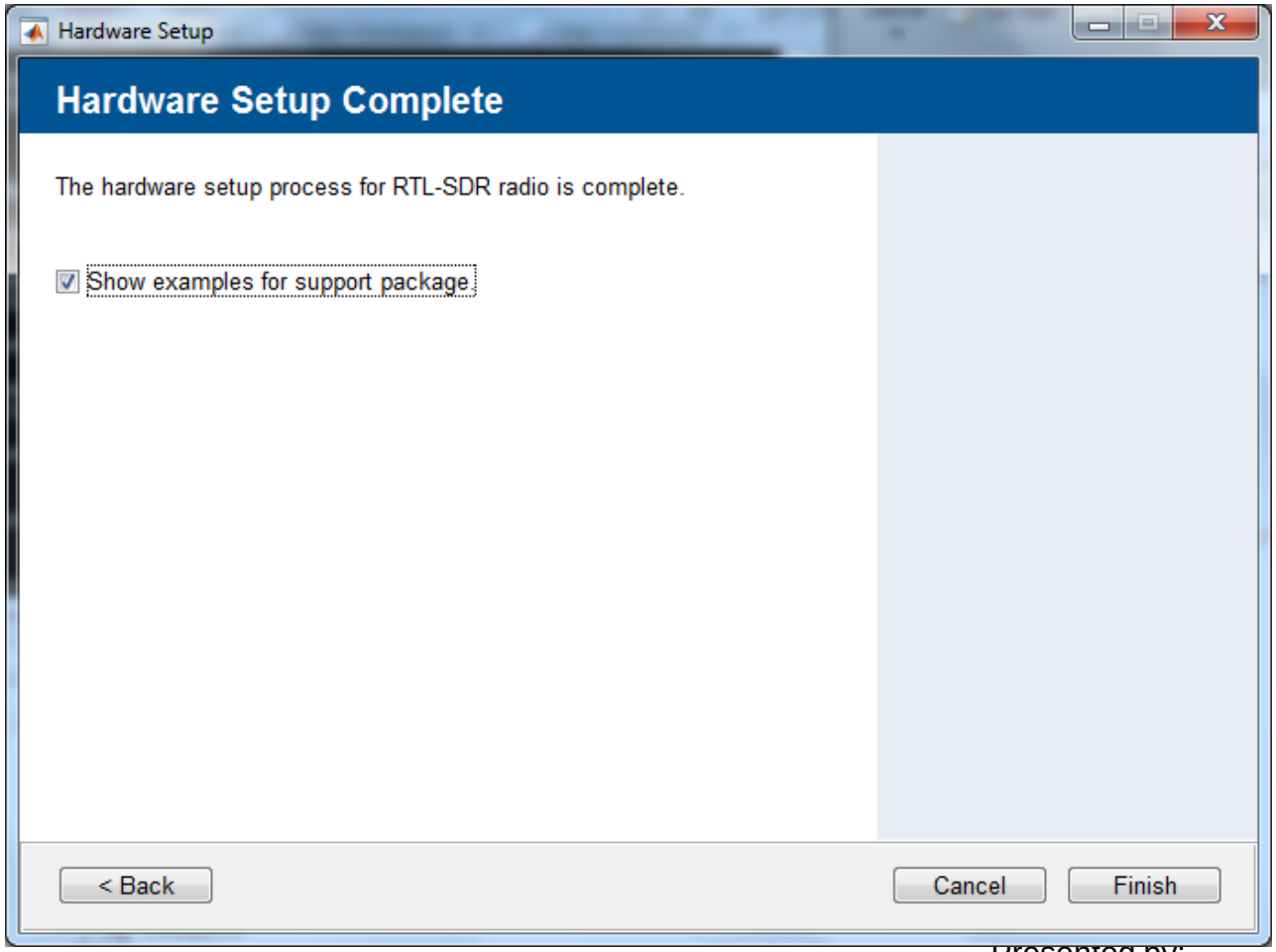
This will go quickly if you already Installed the Drivers



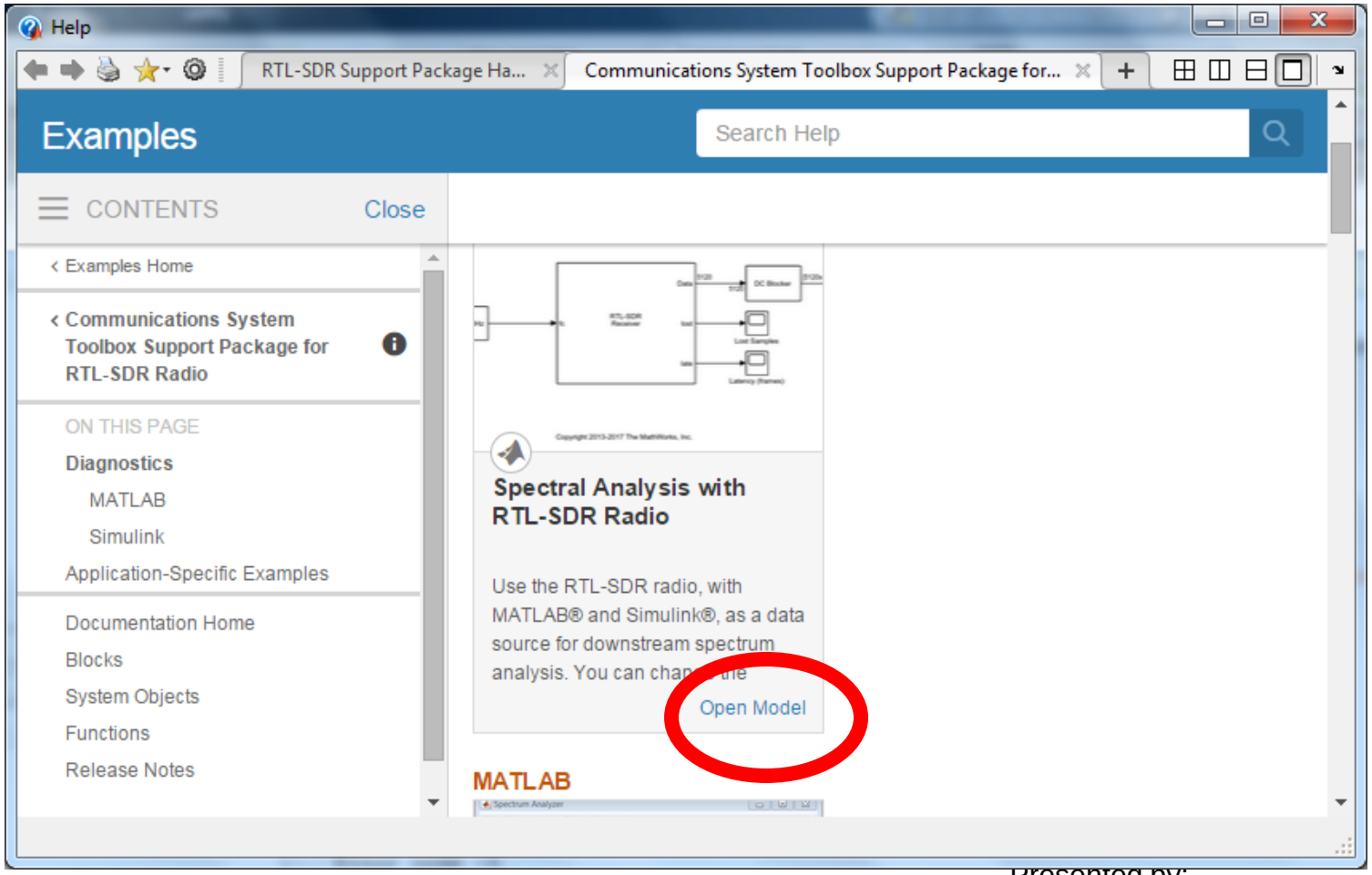
Once Installed



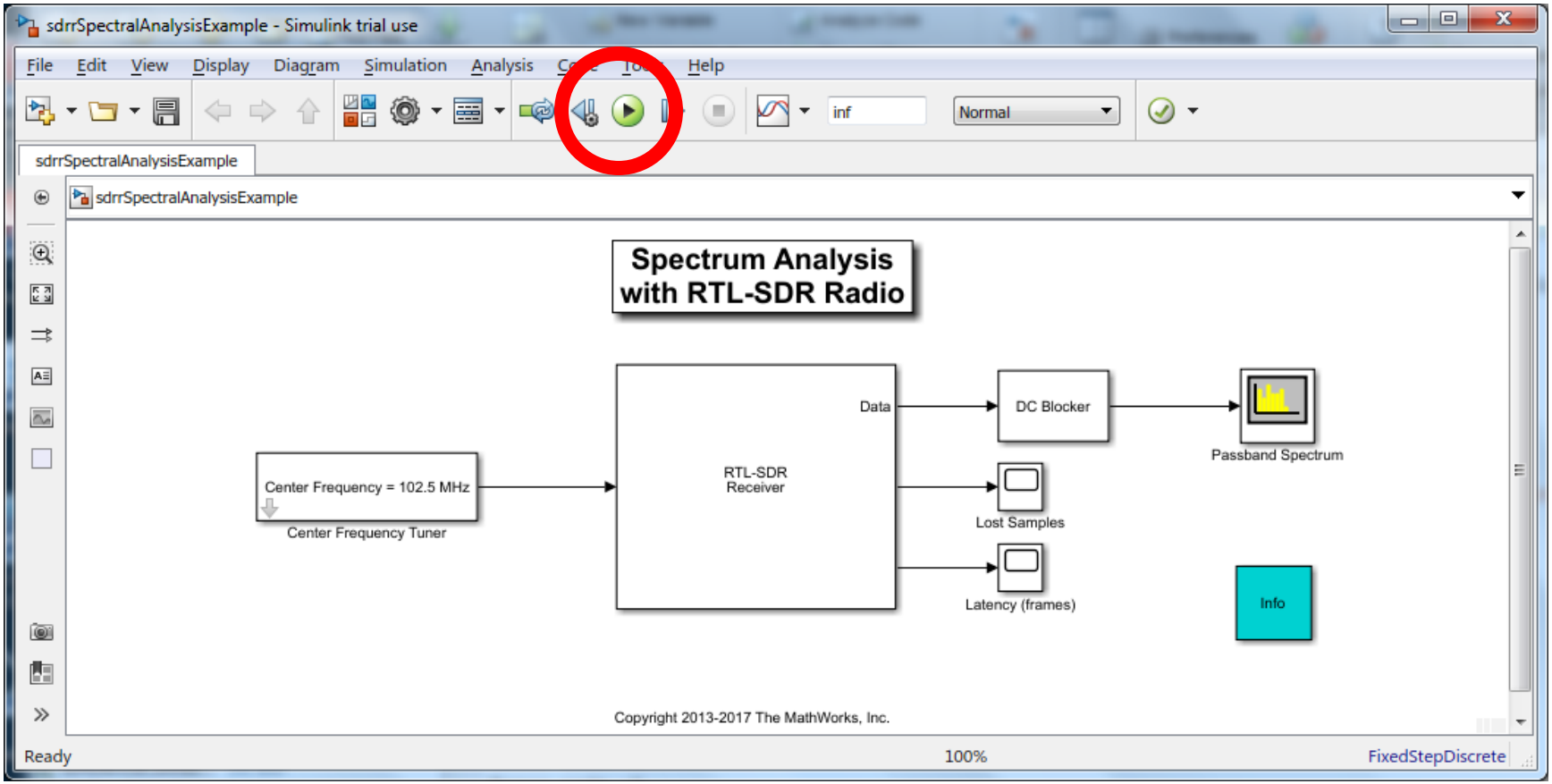
Done

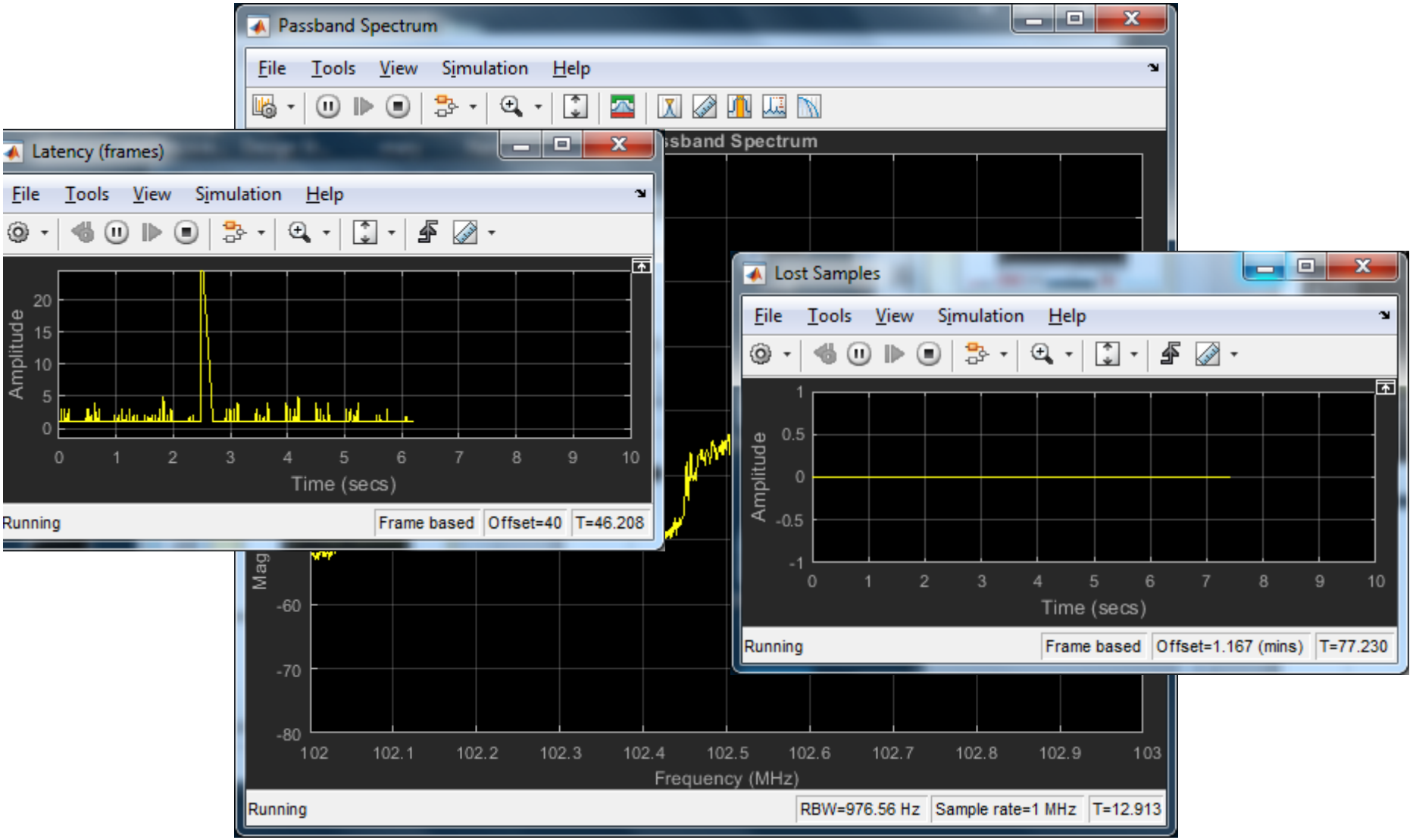


Run an example

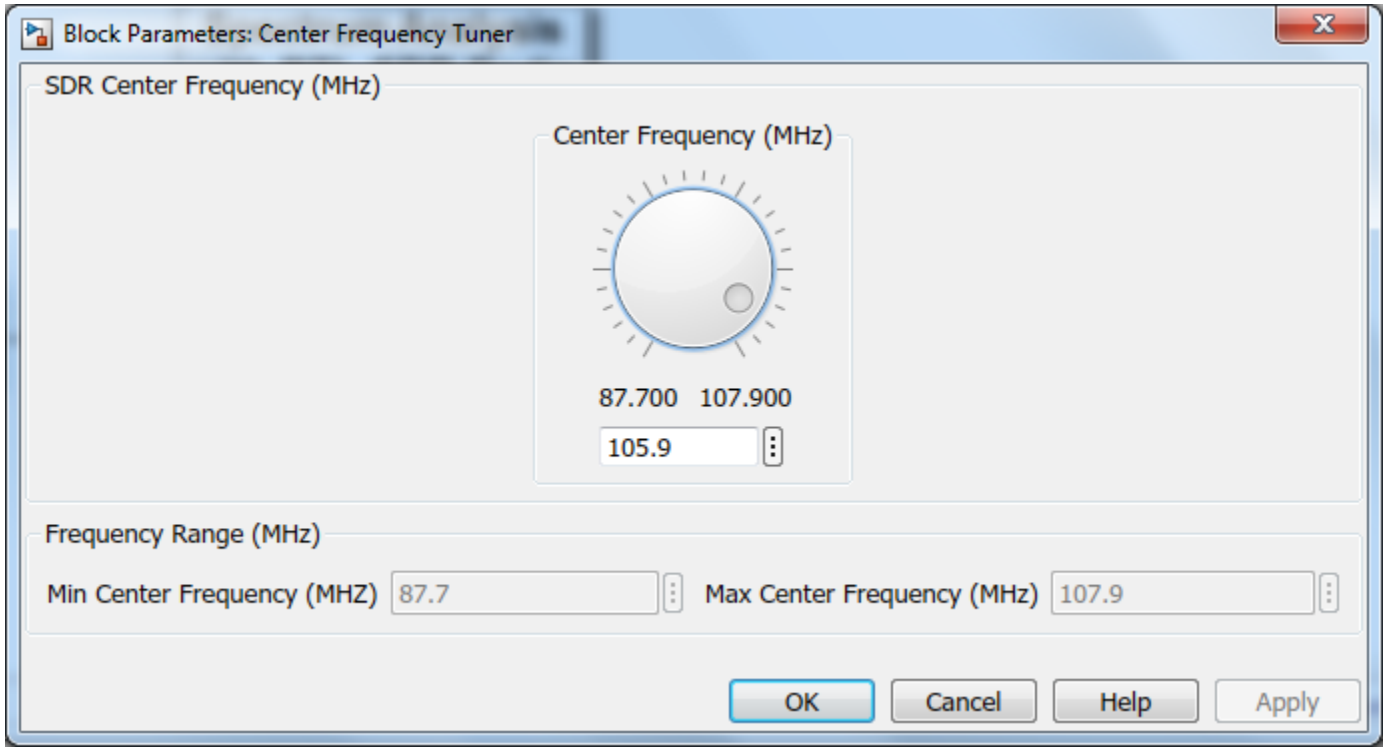


Simulink Modules

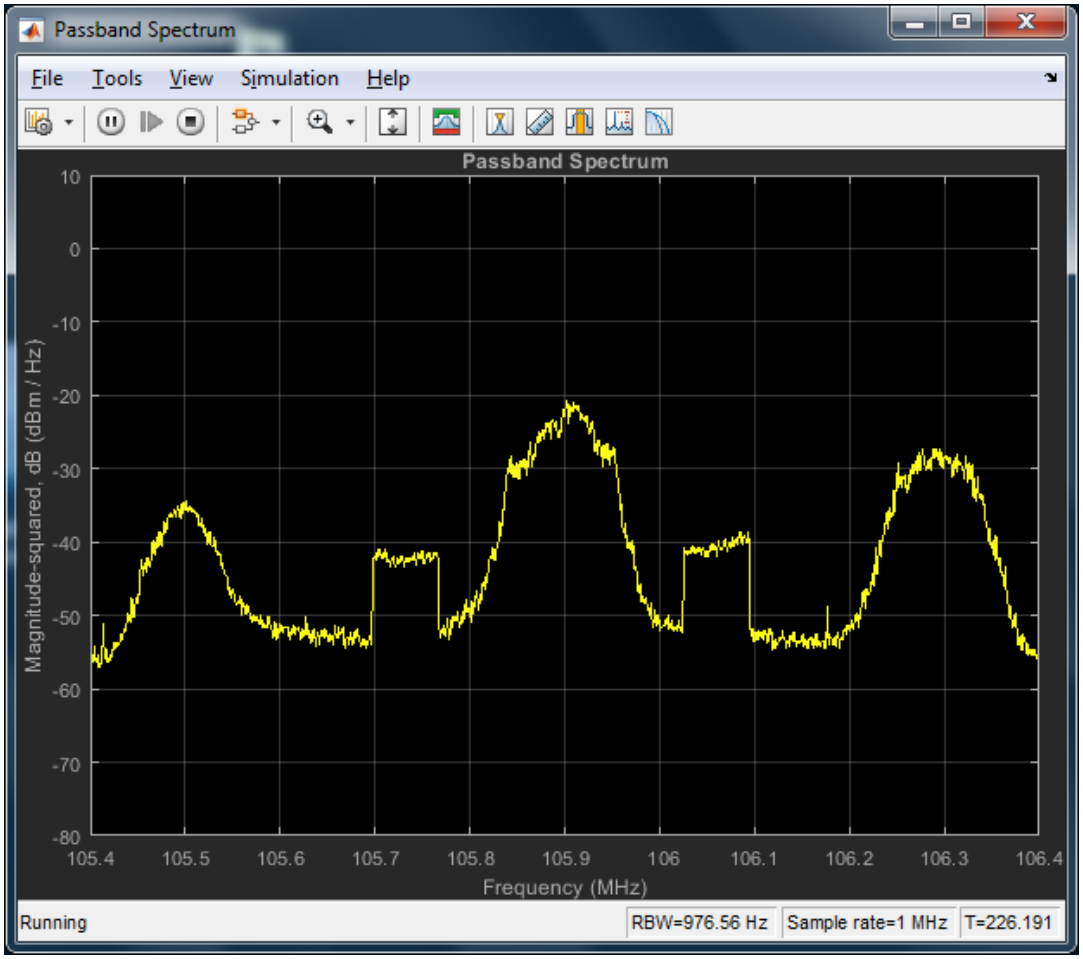




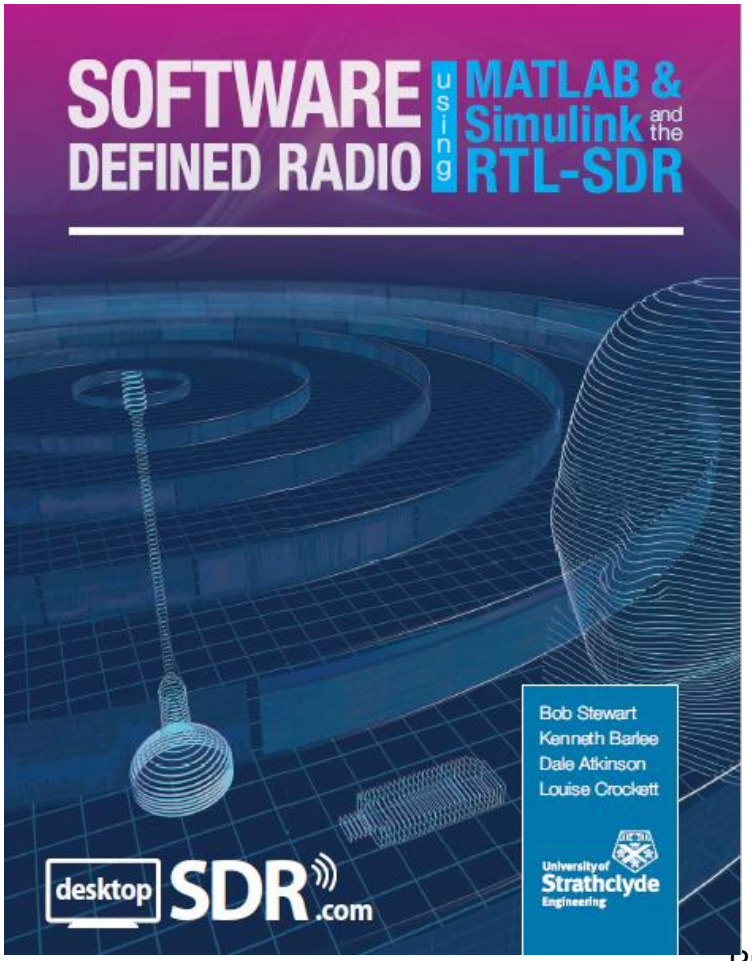
Double Click, Set to Local Station



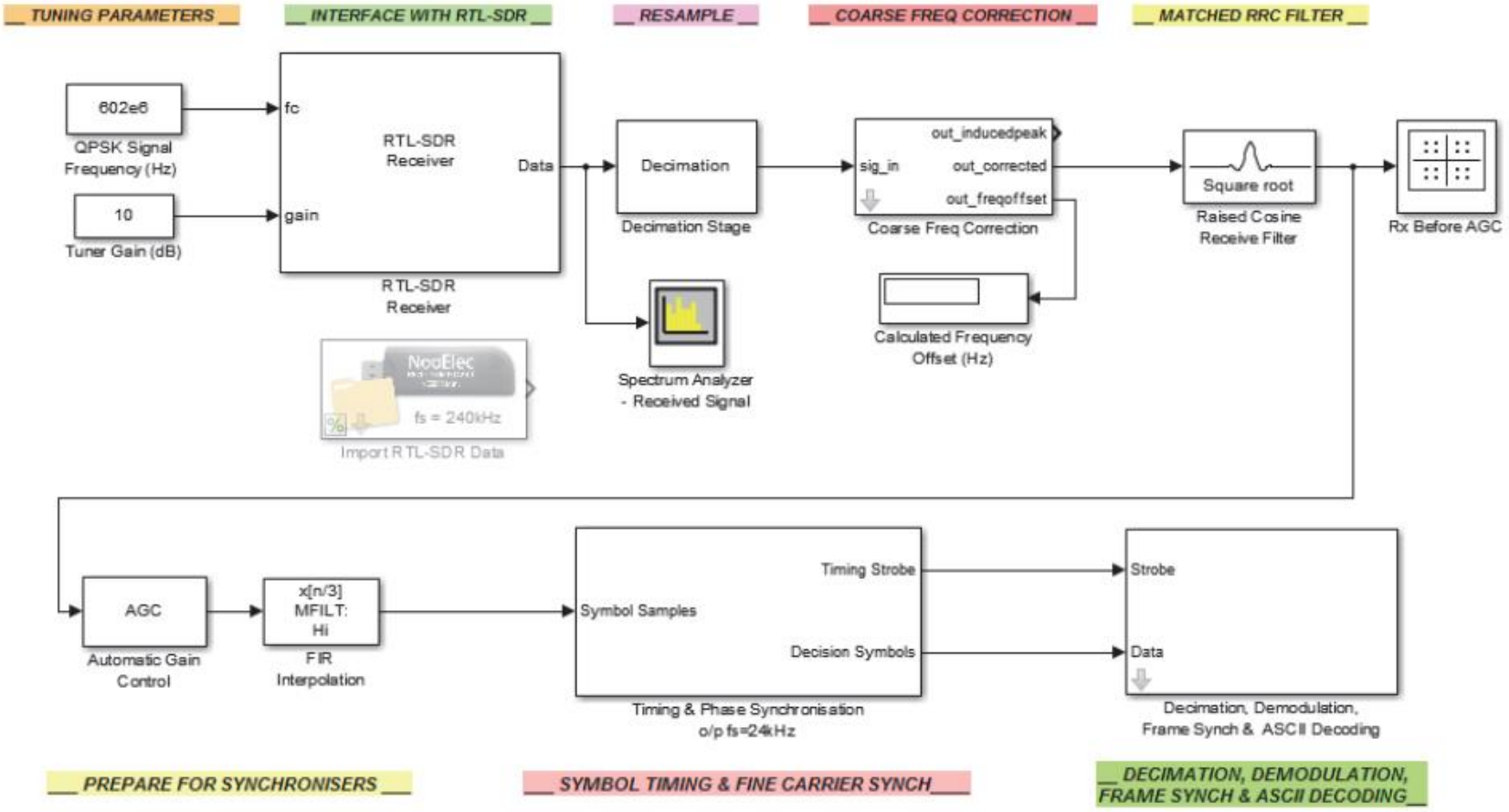
Our Familiar Waveform



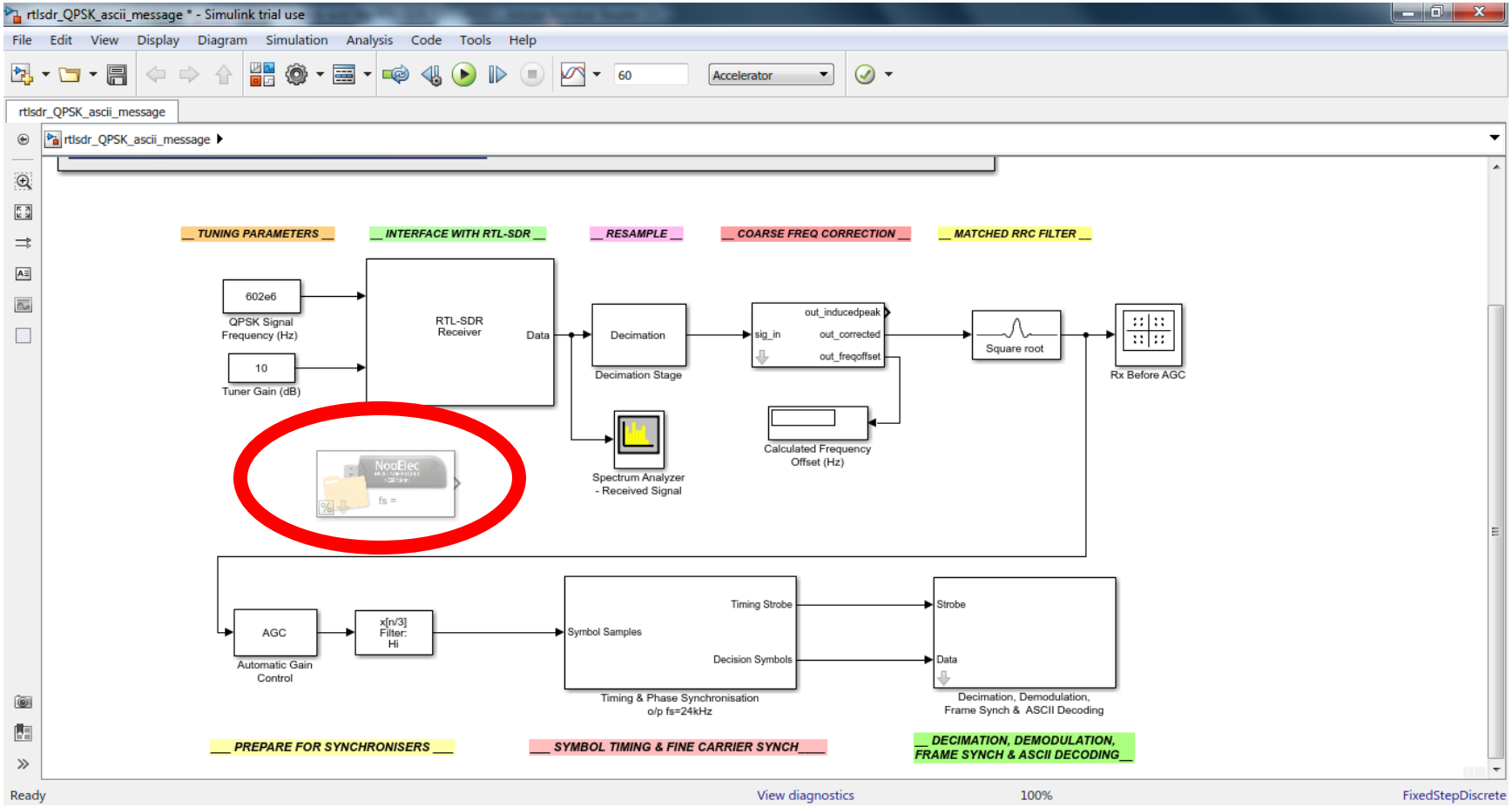
This is the Free Book – With Labs



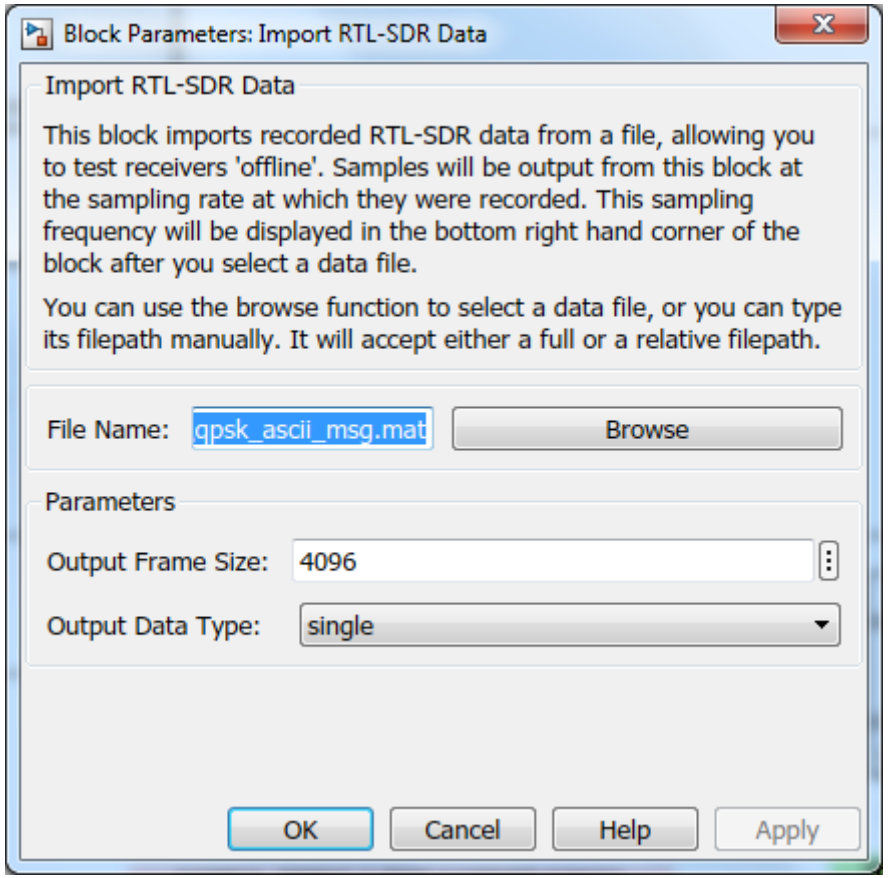
Complete QPSK Receiver



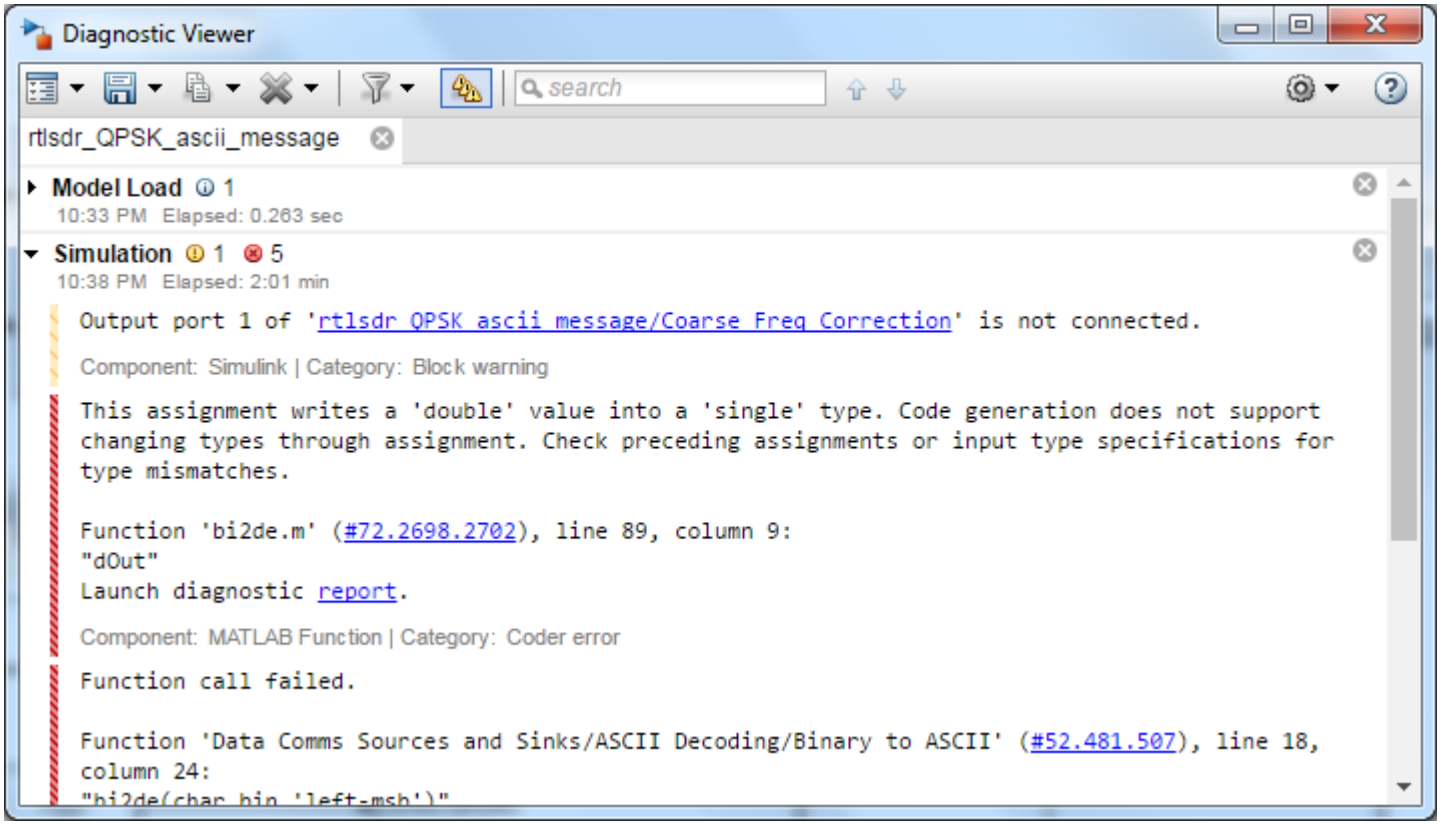
What It Looks Like in Simulink



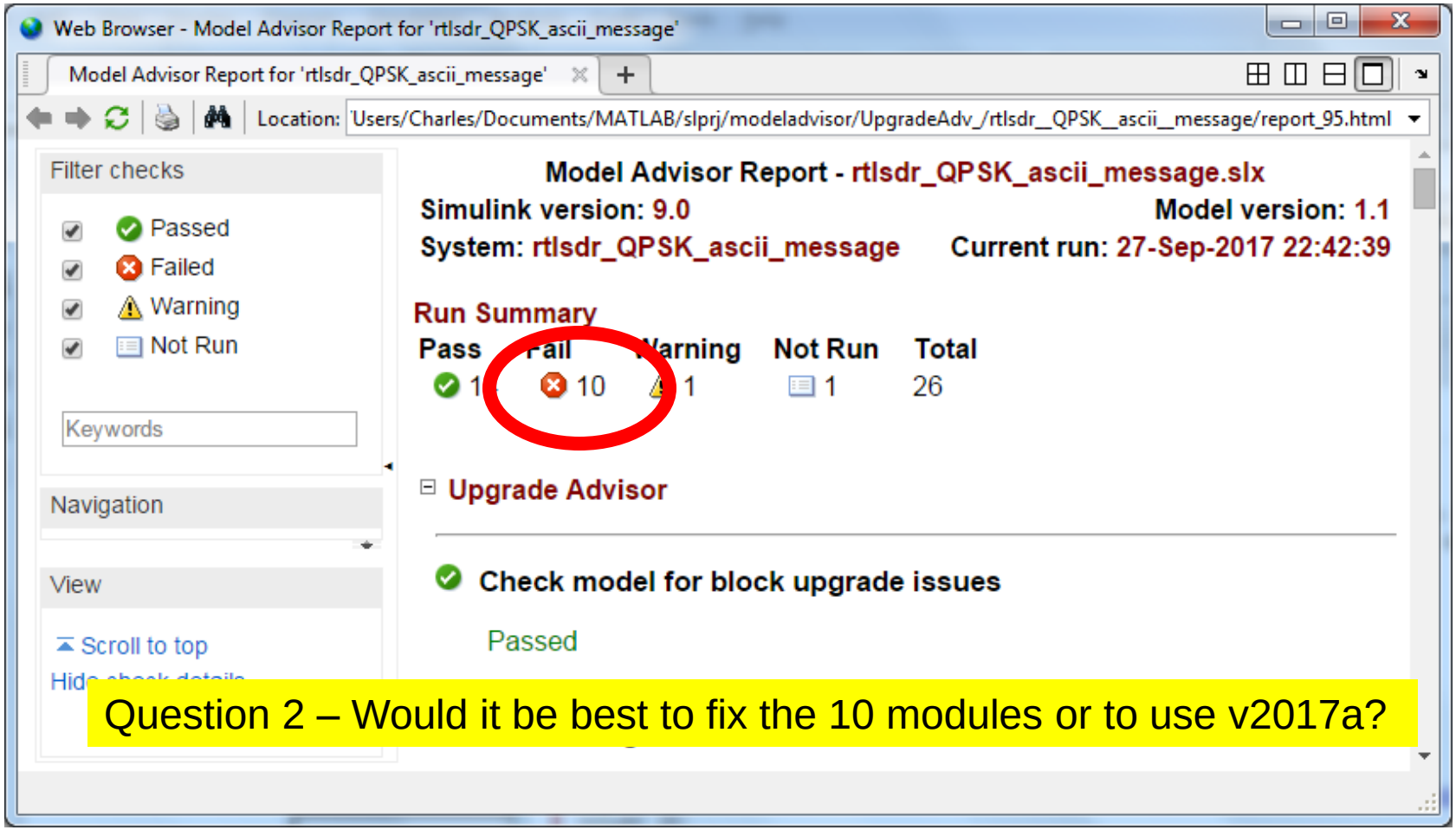
QPSK Data Loaded



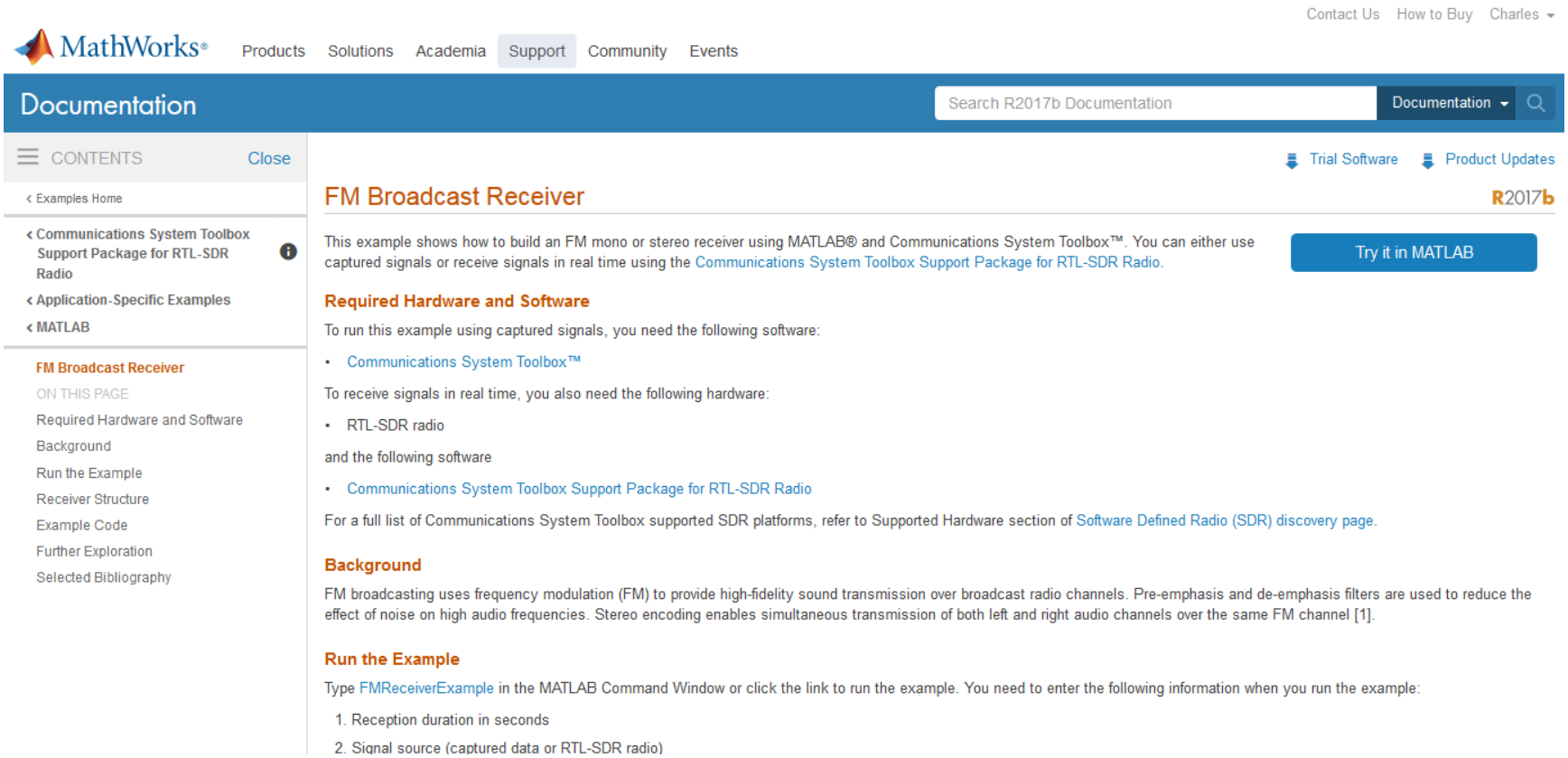
The Examples are in an OLD VERSION



There is an Update Advisor



One Last Example



Contact Us How to Buy Charles

MathWorks® Products Solutions Academia Support Community Events

Documentation

Search R2017b Documentation Documentation

CONTENTS Close

‹ Examples Home

‹ Communications System Toolbox Support Package for RTL-SDR Radio

‹ Application-Specific Examples

‹ MATLAB

FM Broadcast Receiver

ON THIS PAGE

Required Hardware and Software

Background

Run the Example

Receiver Structure

Example Code

Further Exploration

Selected Bibliography

Trial Software Product Updates

FM Broadcast Receiver

R2017b

This example shows how to build an FM mono or stereo receiver using MATLAB® and Communications System Toolbox™. You can either use captured signals or receive signals in real time using the Communications System Toolbox Support Package for RTL-SDR Radio.

Try it in MATLAB

Required Hardware and Software

To run this example using captured signals, you need the following software:

- Communications System Toolbox™

To receive signals in real time, you also need the following hardware:

- RTL-SDR radio

and the following software

- Communications System Toolbox Support Package for RTL-SDR Radio

For a full list of Communications System Toolbox supported SDR platforms, refer to Supported Hardware section of Software Defined Radio (SDR) discovery page.

Background

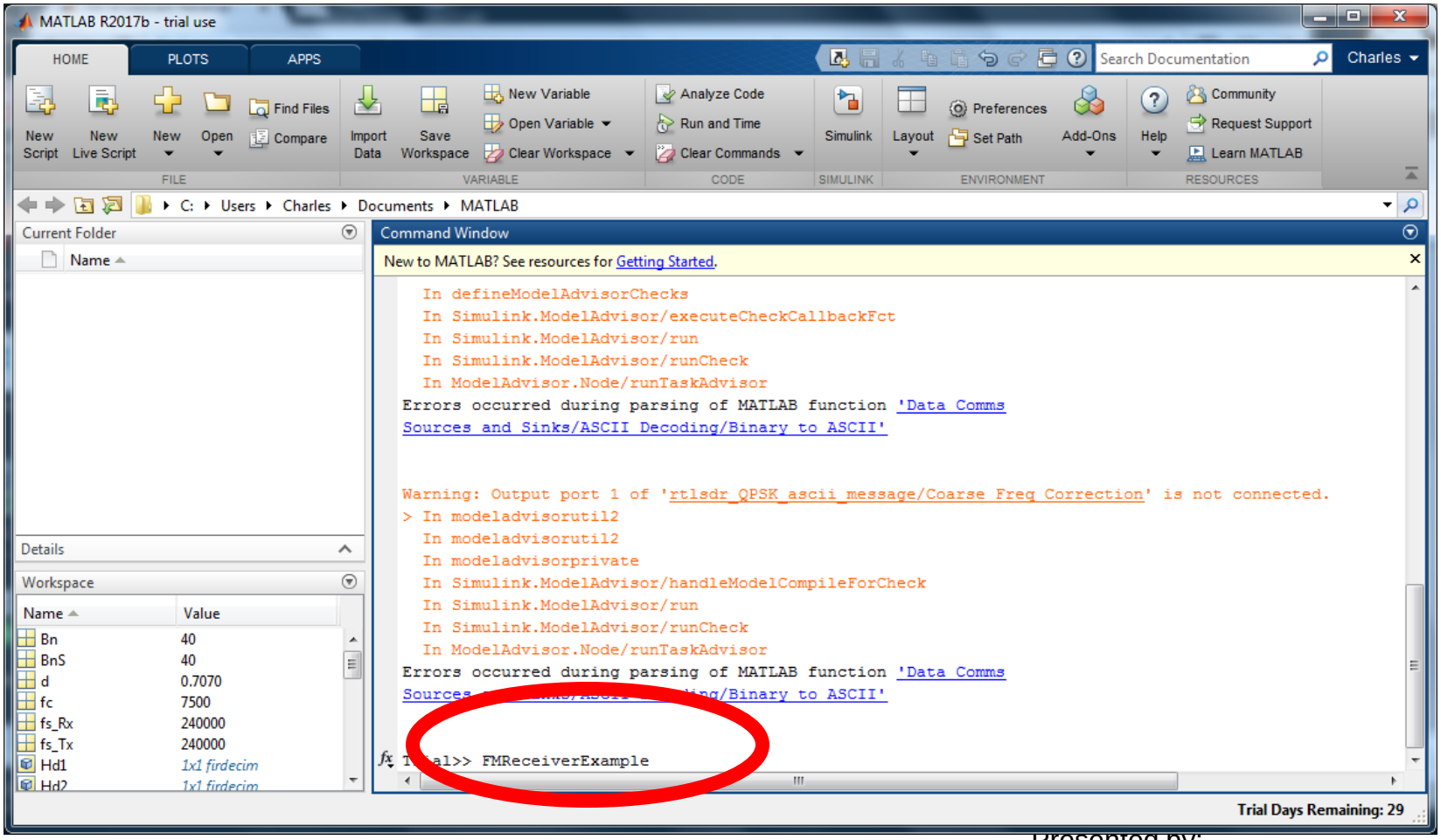
FM broadcasting uses frequency modulation (FM) to provide high-fidelity sound transmission over broadcast radio channels. Pre-emphasis and de-emphasis filters are used to reduce the effect of noise on high audio frequencies. Stereo encoding enables simultaneous transmission of both left and right audio channels over the same FM channel [1].

Run the Example

Type FMReceiverExample in the MATLAB Command Window or click the link to run the example. You need to enter the following information when you run the example:

1. Reception duration in seconds
2. Signal source (captured data or RTL-SDR radio)

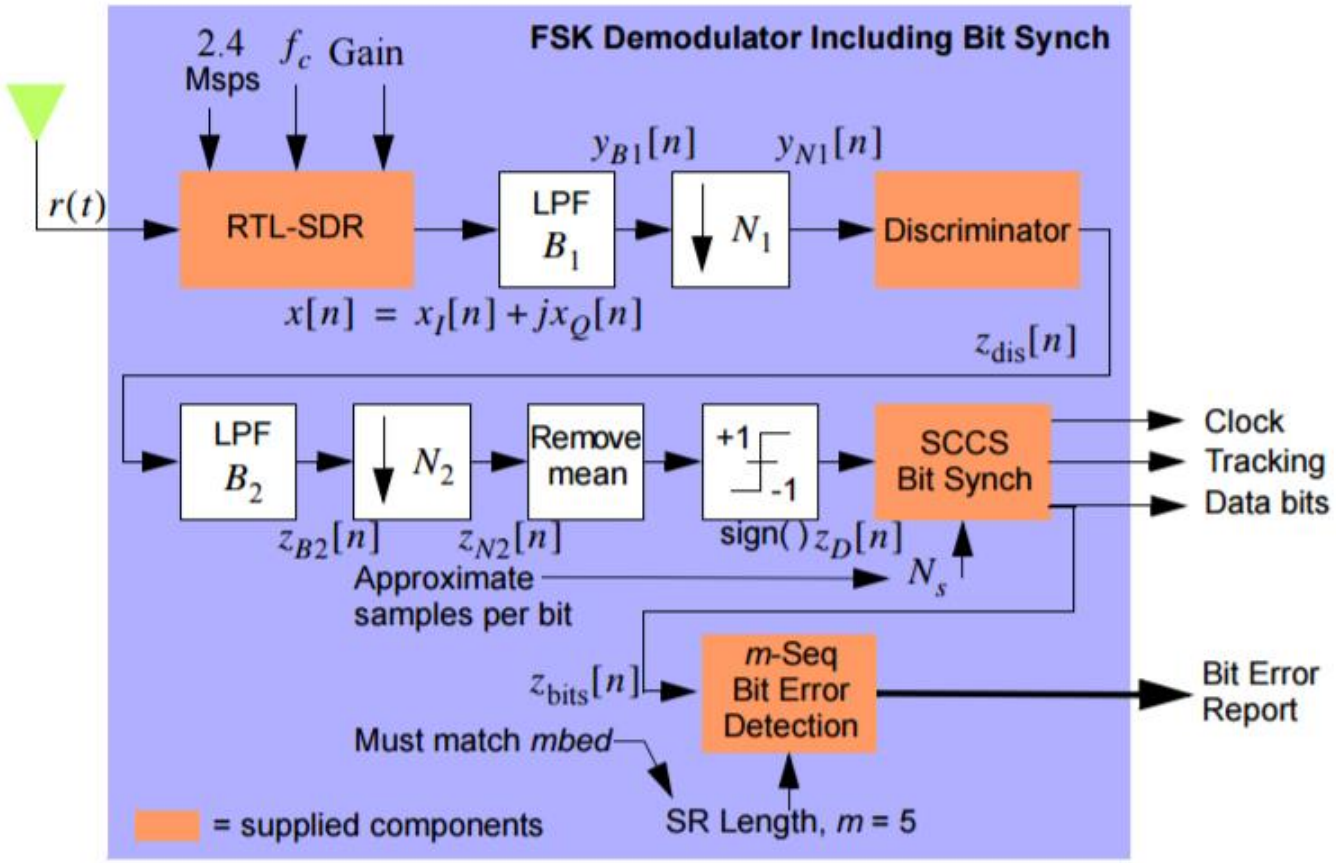
Command Line



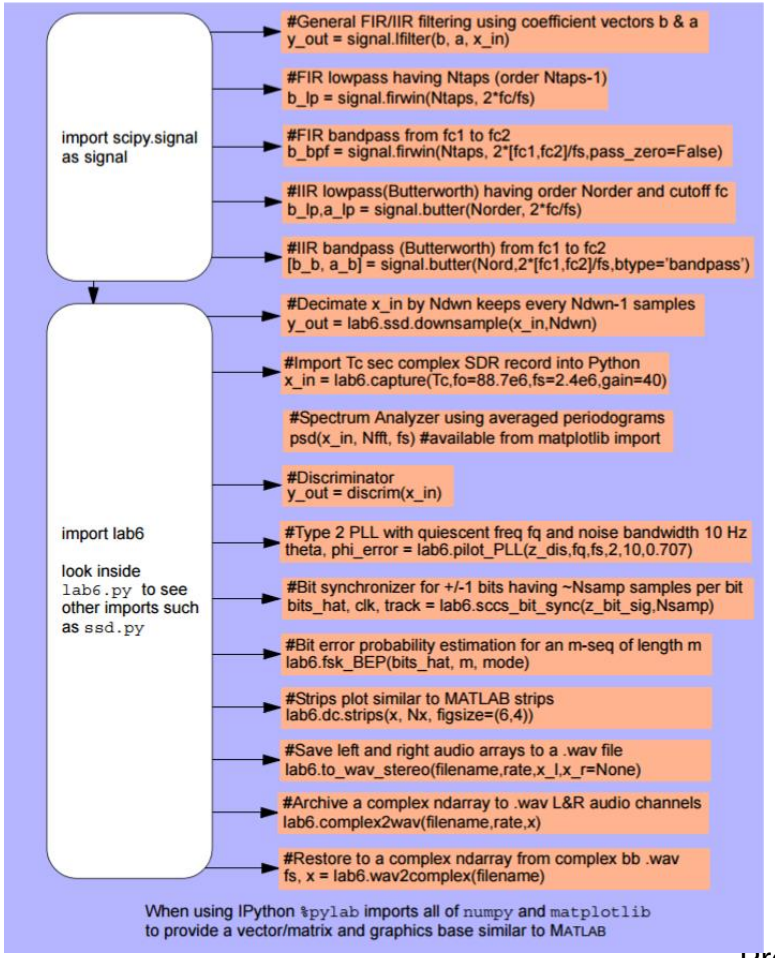
We Go Back to Lab 6

- We will look at the highlights of Wickert's Lab
- He strongly recommended Python over Matlab for his coursework
- Remember, he provides links for both a python interpreter geared toward science / math applications (Anaconda) and a powerful IDE (PyCharm) – and a tutorial as well as sources for the labs

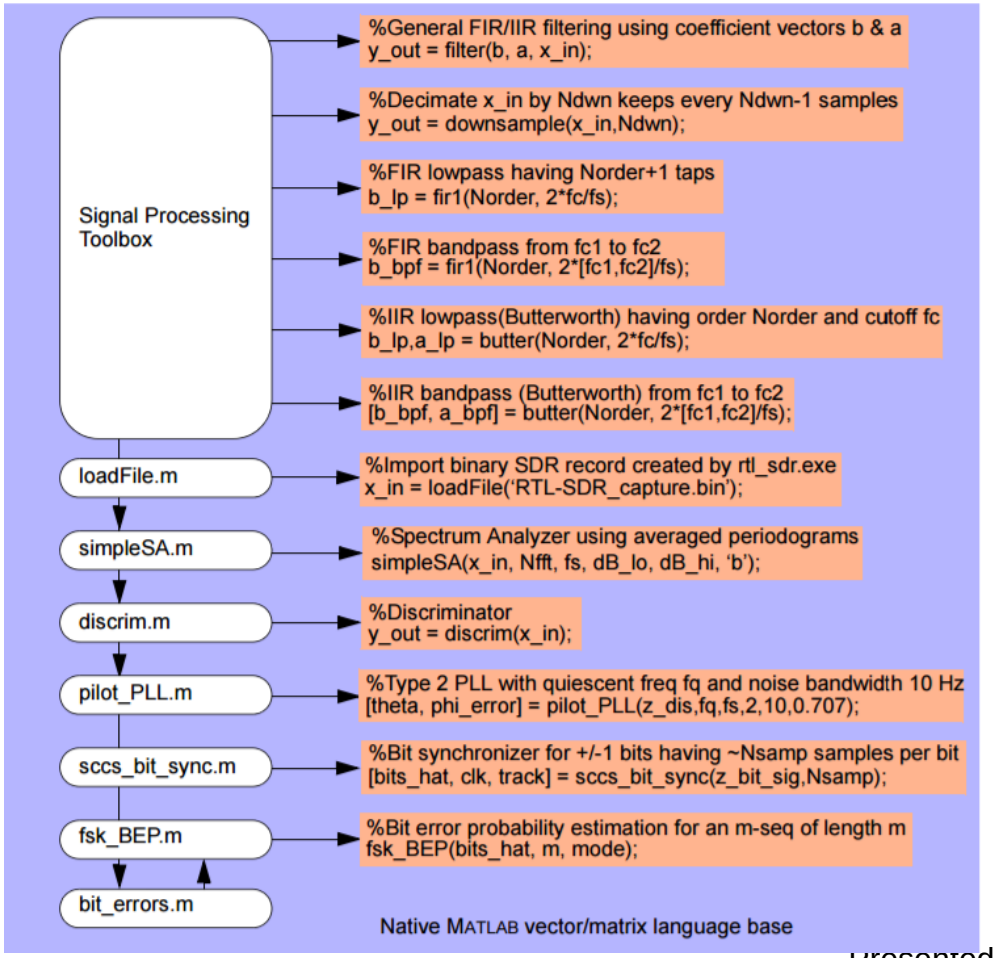
Block Diagram of SDR FSK Receiver



Building Blocks for a Receiver in Python

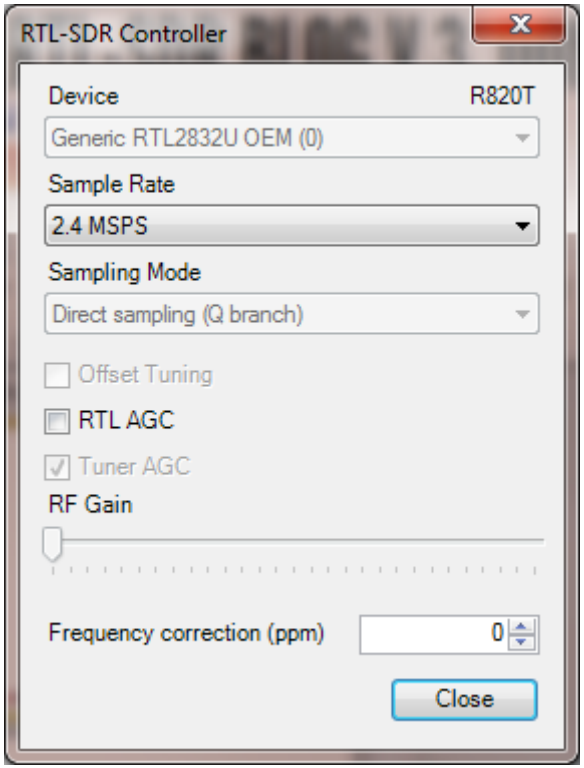


Building Blocks for a Receiver in Matlab

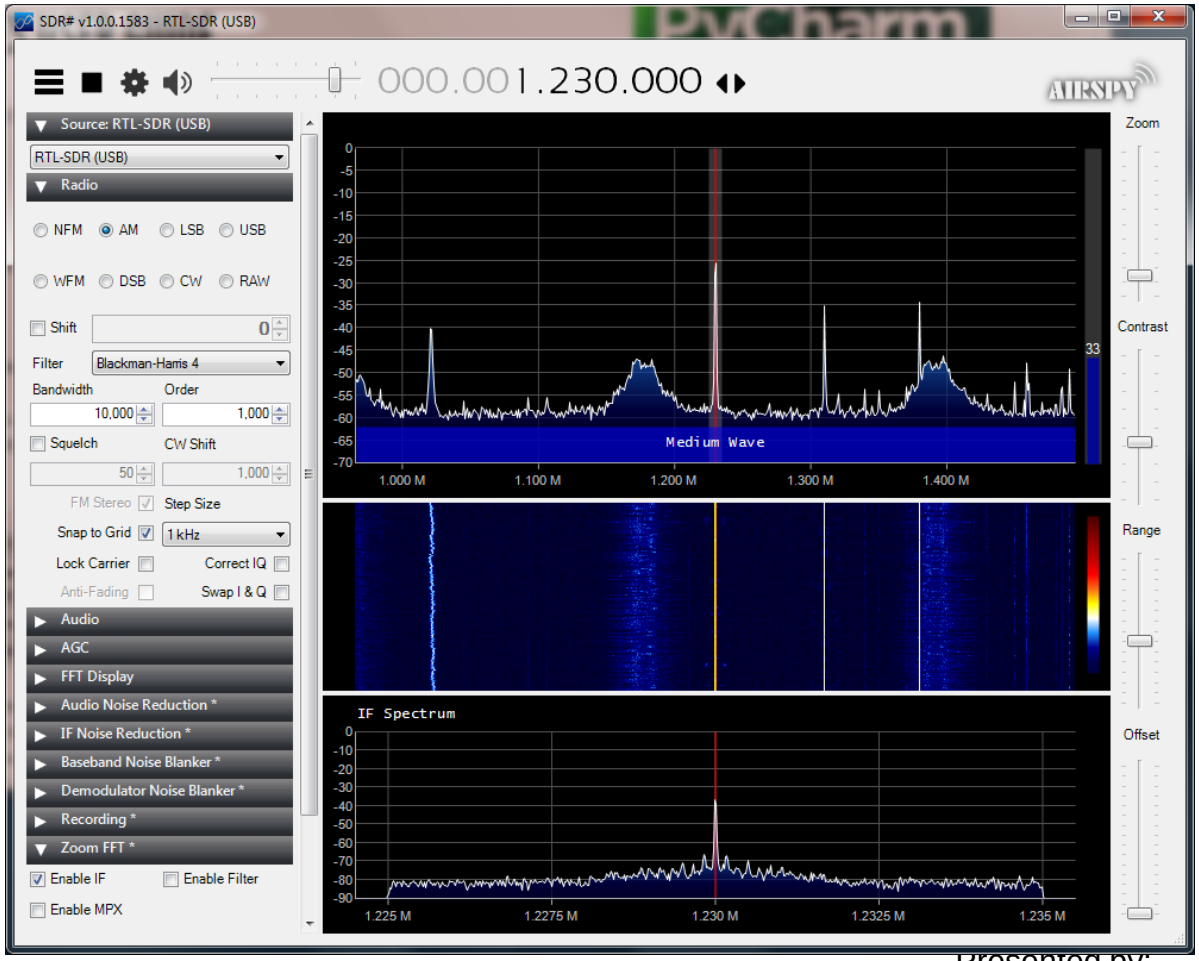


Before Leaving RTL-SDR, Let's Look at Another Popular Dongle

HF? Yes! Direct Sample



1230 Khz AM Broadcast



There are Many More Things to Explore!

- Work Through the labs and write a demodulator
- Build a transmitter and test with your RTL-SDR

Question 3 – What other projects would you build with a RTL-SDR?

- Next Step – build a commercial-quality SDR!

This Week's Agenda

9/25 Intro to SDR

9/26 RF and Radio Basics

9/27 Exploring SDR with the RTL-SDR, Part 1

9/28 Exploring SDR with the RTL-SDR, Part 2

9/29 Commercial SDR Designs

Please stick around as I answer your questions!

- Please give me a moment to scroll back through the chat window to find your questions
- I will stay on chat as long as it takes to answer!
- I am available to answer simple questions or to consult (or offer in-house training for your company)
  c.j.lord@ieee.org
  http://www.blueridgetechnc.com
  http://www.linkedin.com/in/charleslord
  Twitter: @charleslord
  https://www.github.com/bradatraining